

Excel 2016

Math with Dates and Times



Microsoft Excel 2016: Math with Dates and Times

1.5 hour

In this advanced math workshop, we will unlock the secrets of date/time math in Excel; learn lots of shortcuts and custom formatting options; explore many of the built in date/time functions; build our own date/time equations. By the end of this workshop you will be able to create a simple timesheet, and calculate how many days between two dates, excluding holidays and weekends. This advanced workshop assumes prior experience with Microsoft Excel; experience with building equations in Excel required.

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Dates in Excel

If you've ever lost the date formatting on a cell, you have seen it turn into a strange number. For example, according to Excel these cells are the same number:

	A	B
1	10/17/2013	41564

The serial number 41, 564 tells us how many days it has been since January 1st, 1900*. The date serial numbers are sequential, one day at a time:

	A	B
1	10/17/2013	41564
2	10/18/2013	41565
3	10/19/2013	41566

**Note: The default date system for the Macintosh begins with January 1, 1904. This may cause some confusion if you try to use the same file in both a Mac and a PC. The setting can be changed in the Excel Options on the File menu.*

Times in Excel

One day has 24 hours, so in Microsoft Excel, 1 is equivalent to 24 hours, 0.5 is equivalent to 12 hours. If we take our October 17th date, and add in a time of 12:00pm, it translates into 41564.5, the 0.5 representing the half-way point of the day.

1=24 hours, 0.5=12 hours, 0.25=6 hours...

	A	B
1	10/17/13 12:00 PM	41564.5

If you leave the date off a time, Excel will default to 1/0/1900 as the 'understood' date. You can ignore it, but realize that is what happens if you change a time format into a date/time format. All three of these cells contain 12:00 PM, they are just displayed with different formats:

	A	B	C
1	12:00 PM	1/0/1900	1/0/00 12:00 PM

Useful Date/Time Shortcuts

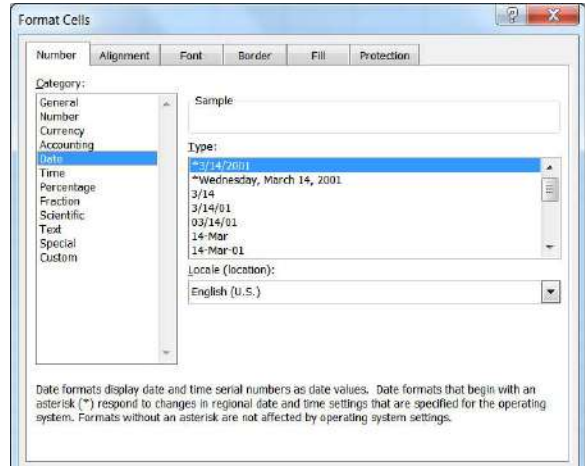
Shortcut	Result	Note
Ctrl-;	Current Date	Control Semicolon
Ctrl-:	Current Time	Control Colon
Shift-Ctrl-3	Formats the cell to show DD-MMM-YYYY	3/# from the full keyboard
Shift-Ctrl-2	Formats the cell to show h:mm AM/PM	2/@ from the full keyboard

Custom Formatting

Days, Months, and Years

You can format a cell with a preset list of options in the Format Cells Window.

- Click the More button in the Number group
- Right-click on a cell and choose Format cells
- Select the cell and press Ctrl-1 to open this window



Excel has a pretty extensive list of date and time formats, but it is possible to custom build a date format, using simple abbreviations.

Dates for Tuesday, February 3, 2004					
Day		Month		Year	
D	3	m	2	yy	04
dd	03	mm	02		
ddd	Tue	mmm	Feb	yyyy	2004
dddd	Tuesday	mmmm	February		

Hours, minutes, and seconds

If you use "m" immediately after the "h" or "hh" code or immediately before the "ss" code, Excel displays minutes instead of the month.

Times for 1:02:05					
Hours		Minutes		Seconds	
H	1	m	2	s	5
hh	01	mm	02	ss	05

If you would like to use the 12 hour clock you need to add the appropriate designator at the end. Access will accept any of the following: AM/PM; am/pm; A/P; a/p; AMPM.

Times for 17:02:05					
Hours		24 hour clock		12 hour clock	
H	17	h:m	17:2	h:m am/pm	5:2 PM
hh	17	h:mm	17:02	h:mm am/pm	5:02 PM
h AM/PM	5 PM	hh:mm	17:02	hh:mm am/pm	05:02 PM

If you need to go smaller, adding .00 after the second format (ss.00) will give the fraction of a second.

Totaling Time

The time formats in Excel stay within the defaults of 24 hours, 60 minutes, 60 seconds. If we do math we may want it to display the times beyond these boundaries. For this, we use the brackets [] around the abbreviation.

Beyond the Boundaries					
36 Hours		75 minutes		75 seconds	
h	12	m	(assumes month)	s	15
hh	12	mm	(assumes month)	ss	15
[h]	36	[m]	75	[s]	75

Simple Date/Time Math

Because dates and times are stored as numbers you can do simple math with them.

Begin	End	Formula	Result
01/02/2013	05/15/2013	=Last Date – First Date	Days Elapsed = 133
8:15 AM	5:00 PM	=Last Time – First Time	Time Elapsed = 8:45 (8 hours 45 minutes)

Times are a fraction of a day. As mentioned earlier, 0.5=12 hours. If we multiply a time by 24 we should get the numeric value.

Time	Time * 24
8:45 AM	6:00 PM

Why doesn't it look right? You have to format the result as a true number field.

Time	Time * 24 (formatted as a number)
8:45 AM	8.75

Remember if you are going beyond the 24 hour clock, you will need to set up a custom format.

Date Worksheet Functions

Adapted from Excel Help

DATE - Returns the sequential serial number that represents a particular date

Syntax: DATE(year, month, day)

Year The value of the year argument can include one to four digits.

Month A positive or negative integer representing the month of the year from 1 to 12. If *month* is greater than 12, *month* adds that number of months to the first month in the year specified

Day A positive or negative integer representing the day of the month from 1 to 31.

Equation	Result	Notes
=DATE(2009, 3, 15)	03/15/2009	
=DATE(5, 10, 15)	10/15/1905	Notice this counts year from 1900, thus will not assume "2005"
=DATE(2010, 15, 20)	03/20/2011	Notice this is going into the following year because 15 months
=DATE(1976, 11, 35)	120/5/1976	Notice this is going into the following month because 35 days
=DATE(2007, -1, 5)	11/05/2006	Negative values will go backwards in time, minus day/year

DATEVALUE - Returns the serial number of a date

Converts a date that is stored as text to a serial number that Excel recognizes as a date. To view a date serial number as a date, you must apply a date format to the cell.

Syntax: DATEVALUE(date_text)

date_text represents a date between 01/01/1900 and 12/31/9999 saved as text

Equation	Result	Notes
=DATEVALUE(3/15/2009)	#VALUE!	Date not in Text format
=DATEVALUE("10/15/1905")	2115	
=DATEVALUE("3/20/2011")	40622	
=DATEVALUE(A1)	#VALUE!	A1 = 12/5/1976
=DATEVALUE(A1)	28099	A1 = "12/5/1976"

DAY - Returns the numeric value of the day in a valid date

Syntax: =DAY(serial number)

Serial Number is the date of the day you are trying to find.

Equation	Result	Notes
=DAY(3/15/2009)	0	Serial Number not a Date (Excel sees 3÷15÷2009)
=DAY("10/15/1905")	15	
=DAY(40622)	20	Equivalent to 3/20/2011
=DAY(A1)	5	A1 = 12/5/1976

DAYS360 - returns the number of days between two dates based on a 360-day year

360 day year assumes twelve 30-day months, this is often used with accounting calculations. If *start_date* occurs after *end_date*, the DAYS360 function returns a negative number.

Syntax: DAYS360(start_date, end_date, [method])

Start Date and *End Date* are valid dates which represent the starting and ending dates. *Method*

Optional logical value that specifies whether to use the U.S. (NASD) or European method in the calculation. False or omitted will give us the U.S. method, True will use the European method.

Remarks: If *start_date* is the last day of the month, both methods set the start_date to the 30th of the month, but if the *end_date* is the last day of the month the US method will change the date to the 1st of the next month, the European will change the date to the 30th.

Equation	Result	Notes
=DAYS360(A1, A2)	8	A1 = 02/27/2009, A2 = 03/05/2009
=DAYS360(B1, B2)	1	B1 = 01/30/2009, B2 = 02/01/2009
=DAYS360(C1, C2)	1	C1 = 01/31/2009, C2 = 02/01/2009
=DAYS360(D1, D2)	360	D1 = 11/15/2009, D2 = 11/15/2010

EDATE - Returns serial number of the date that is a number of months away from a date

Syntax: EDATE(start_date, months)

Start Date is a valid date that represents the starting date

Months is the number of months before or after start_date. A positive value for months yields a future date; a negative value yields a past date

Equation	Result	Notes
=EDATE(A1, 1)	39899 03/27/2009	A1 = 02/27/2009
=EDATE(A1, 10)	40174 12/27/2009	A1 = 02/27/2009
=EDATE(A1, 100)	42913 06/27/2017	A1 = 02/27/2009
=EDATE(A1, -1)	39840 01/27/2009	A1 = 02/27/2009

EOMONTH - Returns serial number for the last day of the month

EOMonth => End of month

Syntax: EOMONTH(start_date, months)

Start Date is a valid date that represents the starting date

Months number of months before or after start_date. A positive value for months yields a future date; a negative value yields a past date.

Equation	Result	Notes
=EOMONTH(A1, 1)	39903 03/31/2009	A1 = 02/27/2009
=EOMONTH(A1, 10)	40178 12/31/2009	A1 = 02/27/2009
=EOMONTH(A1, 100)	42916 06/30/2017	A1 = 02/27/2009
=EOMONTH(A1, -1)	39844 01/31/2009	A1 = 02/27/2009

MONTH- Returns the numeric value of the month in a valid date

Syntax: =MONTH(serial number)

Serial Number is the date of the month you are trying to find.

Equation	Result	Notes
=MONTH("10/15/1905")	10	
=MONTH(40622)	3	Equivalent to 3/20/2011
=MONTH(A1)	12	A1 = 12/5/1976

TODAY - the serial number of the current date

Syntax: TODAY()

Equation	Result	Notes
=TODAY()	12/5/2016	This will always be the current date.

NETWORKDAYS - returns the number of whole working days between two dates

Syntax: NETWORKDAYS(start_date, end_date, holidays)

Start Date and *End Date* are valid dates.

Holidays is an optional range of one or more dates to exclude from the working calendar. The list can be either a range of cells that contains the dates or an array constant of the serial numbers that represent the dates

Equation	Result	Notes
=NETWORKDAYS(A1, A2)	5	A1 = 02/27/2009, A2 = 03/05/2009
=NETWORKDAYS(B1, B2)	1	B1 = 01/30/2009, B2 = 02/01/2009
=NETWORKDAYS(C1, C2)	12	C1 = 07/01/2009, C2 = 07/15/2009
=NETWORKDAYS(C1, C2, C3)	11	C1 = 07/01/2009, C2 = 07/15/2009, C3 = 07/04/1999
=NETWORKDAYS(D1, D2, D3:D4)	259	D1 = 11/15/2009, D2 = 11/15/2010, D3 = 01/01/2010, D4 = 07/04/2010

WEEKDAY - Returns the day of the week corresponding to a date

Syntax: =WEEKDAY(serial number, return_type)

Serial Number is the date of the day you are trying to find.

Return Type is a number that determines the type of return value. 1 or omitted sees the week as 1-Sunday, 7-Saturday. 2 sees the week as 1-Monday, 7-Sunday. 3 sees the week as 0-Monday, 6-Sunday.

Equation	Result	Notes
=WEEKDAY("12/15/1976")	4	Wednesday, December 15, 1976
=WEEKDAY(40622)	1	Sunday, March 20, 2011
=WEEKDAY(A1)	7	A1 = Saturday, October 28, 1905

WEEKNUM - Returns the day of the week corresponding to a date

Syntax: =WEEKNUM(serial number, return_type)

Serial Number is the date of the day you are trying to find.

Return Type is a number that determines the type of return value. **1** - Week begins on Sunday. Weekdays are numbered 1 through 7; **2** - Week begins on Monday. Weekdays are numbered 1 through 7.

Remarks: The WEEKNUM function considers the week containing January 1 to be the first week of the year.

Equation	Result	Notes
=WEEKNUM("12/15/1976")	51	Wednesday, December 15, 1976
=WEEKNUM(40622)	13	Sunday, March 20, 2011
=WEEKNUM(A1)	43	A1 = Saturday, October 28, 1905

WORKDAY - Returns a date that is a number of working days before or after a date

Syntax: WORKDAY(start_date, days, holidays)

Start Date is a valid date that represents the starting date.

Days is the number of non-weekend and non-holiday days before or after start_date. A positive value yields a future date; a negative value, a past date.

Holidays is an optional range of one or more dates to exclude from the working calendar. The list can be either a range of cells that contains the dates or an array constant of the serial numbers that represent the dates

Equation	Result		Notes
=WORKDAY(A1, 1)	39874	Mon 3/2/09	A1 = 02/27/2009
=WORKDAY(A1, 10)	39885	Fri 3/13/09	A1 = 02/27/2009
=WORKDAY(A1, 100)	40011	Fri 7/17/09	A1 = 02/27/2009
=WORKDAY(C1, 100, C3)	40135	Wed 11/18/09	C1 = 07/01/2009, C2 = 07/04/2009
=WORKDAY(D1, D2, D3:D4)	40274	Tue 4/6/10	D1 = 11/15/09, D2 = 100, D3 = 1/1/10, D4 = 1/18/10

YEAR- Returns the numeric value of the year in a valid date

Syntax: =YEAR(serial number)

Serial Number is the date of the year you are trying to find.

Equation	Result	Notes
=YEAR("10/15/1905")	5	
=YEAR(40622)	2011	Equivalent to 3/20/2011
=YEAR(A1)	1976	A1 = 12/5/1976

YEARFRAC - Returns fraction of the year of the number of whole days between two dates

Syntax: YEARFRAC(start_date, end_date, basis)

Start Date and *End Date* are valid dates which represent the starting and ending dates

Basis is the type of day count basis to use

0-US/NASD 30/360; **1**-Actual/Actual; **2**-Actual/360; **3**-Actual/365; **4**-European 30/360

Equation	Result	Notes
=YEARFRAC(A1, A2)	1	A1 = 1/1/2009, A2 = 1/1/2010
=YEARFRAC(A1, A3)	1.013888889	A1 = 1/1/2009, A3 = 1/1/2010
=YEARFRAC(A1, A4)	0.455555556	A1 = 1/1/2009, A4 = 6/15/2009
=YEARFRAC(A1, A5)	0.538888889	A1 = 1/1/2009, A5 = 7/15/2009
=YEARFRAC(A1, A6)	13.53888889	A1 = 1/1/2009, A6 = 7/15/2022

Time Functions

HOUR - Returns the hour of a time value

Syntax: HOUR(serial_number)

Serial_Number the time that contains the hour you want to find.

Remarks: Times may be entered as text strings within quotation marks (for example, "6:45 PM"), as decimal numbers (for example, 0.78125, which represents 6:45 PM), or as results of other formulas or functions (for example, TIMEVALUE("6:45 PM")).

Equation	Result	Notes
=HOUR(A1)	20	A1 = 8:28 PM
=HOUR(B1)	8	B1 = 8:28 AM
=HOUR(C1)	15	C1 = 15:43:12
=HOUR(D1)	17	D1 = 1/2/2003 17:52

MINUTE- Returns the hour of a time value

Syntax: MINUTE (serial_number)

Serial_Number the time that contains the hour you want to find.

Remarks: Times may be entered as text strings within quotation marks (for example, "6:45 PM"), as decimal numbers (for example, 0.78125, which represents 6:45 PM), or as results of other formulas or functions (for example, TIMEVALUE("6:45 PM")).

Equation	Result	Notes
=MINUTE(A1)	28	A1 = 8:28 PM
=MINUTE(C1)	43	C1 = 15:43:12
=MINUTE(D1)	52	D1 = 1/2/2003 17:52

NOW - the serial number of the current date and time

Syntax: NOW()

Equation	Result	Notes
=NOW()	3/7/2009 11:02	This will always be the current date/time.

SECOND - Returns the Seconds of a time value

Syntax: SECOND(serial_number)

Serial_Number the time that contains the hour you want to find.

Remarks: Times may be entered as text strings within quotation marks (for example, "6:45 PM"), as decimal numbers (for example, 0.78125, which represents 6:45 PM), or as results of other formulas or functions (for example, TIMEVALUE("6:45 PM")).

Equation	Result	Notes
=SECOND(A1)	0	A1 = 8:28 PM
=SECOND(C1)	12	C1 = 15:43:12
=SECOND(D1)	15	D1 = 1/2/2003 17:52:15

TIME - Returns the sequential serial number that represents a particular time

Syntax: TIME(hour, minute, second)

Hour is a number from 0 (zero) to 32767 representing the hour. Any value greater than 23 will be divided by 24 and the remainder will be treated as the hour value

Minute is a number from 0 to 32767 representing the minute. Any value greater than 59 will be converted to hours and minutes.

Second is a number from 0 to 32767 representing the second. Any value greater than 59 will be converted to hours, minutes, and seconds.

Equation	Result	Notes
=TIME(15, 3, 15)	3:03:20 PM	
=TIME(0, 0, 2000)	12:33:20 AM	2000 seconds = 33 min, 20 sec
=TIME(C1, C2, C3)	6:12:09 AM	

TIMEVALUE - Returns the serial number of a time

Converts a time that is stored as text to a serial number that Excel recognizes as a time. To view a time serial number as a time, you must apply a time format to the cell.

Syntax: TIMEVALUE(time_text)

time_text represents a time between 01/01/1900 and 12/31/9999 saved as text

Equation	Result	Notes
=TIMEVALUE("3:03:20 PM ")	0.627314815	
=TIMEVALUE("12:33:20 AM ")	0.023148148	
=TIMEVALUE(A1)	#VALUE!	A1 = 6:12:09 AM (not text)
=TIMEVALUE(A1)	0.2584375	A1 = "6:12:09 AM "

Datedif Function

There is a "hidden" function that can find the difference between two dates and return different increments. When you subtract two dates you get the number of days between them. The Datedif function is not in the help files or list of formats, but is probably one of the most powerful date related worksheet functions.

Syntax: DATEDIF(Begin Date, End Date, "Interval")

	A	B	C
1	Begin Date	End Date	
2	1/2/2013	5/15/2015	
3			
4	Result	Difference	Formula
5	863	Days	=DATEDIF(A2,B2,"d")
6	28	Months	=DATEDIF(A2,B2,"m")
7	2	Years	=DATEDIF(A2,B2,"y")

Interval	Description
D	Number of Days
M	Number of Months
Y	Number of Years
YM	Number of months, not counting years
YD	Number of days, not counting years
MD	Number of days, not counting years and months

Class Exercise

Open "Dates-1-FormatsFills"

1) Sheet "Shortcuts"

- B2: Enter a date month and day only (7/4)
- B3: Enter a date with the year (7/4/2016)
- B2: Enter a date with the year (7/4/2016)
 - Format doesn't change
- Select B2:B3
 - From the Number Format drop down, choose Short Date
 - From the Number Format drop down, choose Long Date
 - Press Shift-Ctrl-3 to Quick-format
 - Format Cells (More Numbers) view date formats

- B6: Press Ctrl-Semicolon (Ctrl-;)
- B7: Press Ctrl-Colon (Ctrl-:)
- B8: Press Ctrl-Semicolon, press a space, Press Ctrl-Colon
- D6: =B6
- D7: =B7
- D8: =B8
- Select D6:D8
- Format number to GENERAL
- Dates - How many days since 1/1/1900
- Times - fraction of a 24 hour clock

- B11: =Today()
- B12: =Now()
 - Reformat to only show time

2) Sheet "Date Formats"

- Select A3:F3
- Press Ctrl-; and then Press Ctrl-Enter
 - Today's date should appear in all the cells
- Select each cell and set a custom format
 - B3: DDD
 - C3: DDDD
 - D3: MMM
 - D4: MMMM
 - D4: DDDD, MMMM D, YYYY

3) Sheet "V-Date Pattern"

- Select A3:C3, Drag fill handle to row 10
- Select D3:E3, Drag fill handle to row 10
- Select F3:G3, Drag fill handle to row 10

4) Sheet " H-Date Pattern"

- Select B1:B7
- Drag Fill handle to Column G

5) Sheet "AutoFill Days"

- Select A2:D2, Enter today's date
 - Ctrl-; then Ctrl-Enter
- Use Fill handle on each column one at a time
 - Select A2, Fill to Row 10
 - Select B2, Fill to Row 10, change fill options to By Weekday
 - Select C2, Fill to Row 10, change fill options to By Month
 - Select D2, Fill to Row 10, change fill options to By Year
- In F2 and F3 put the next two pay days
 - Select **both** dates and fill to row 10

Open "Dates-2-ApptDates"

1) Sheet "Past Appts"

- Simple Math, **Reformat to General as needed**
 - D3: =today()-A3
 - E3: =(today()-A3)/30
 - F3: =(today()-A3)/365
- DateDif function
 - *See Page 9 for details*
 - G3: =datedif(A3, today(), "D")
 - H3: =datedif(A3, today(), "M")
 - I3: =datedif(A3, today(), "Y")

2) Sheet "Future Appts"

- D2: =A2+5
- E2: =Workday(A2, 5)
 - *See Page 6 for details*

3) Sheet "End and Begin Month"

- EOMonth function
 - *See Page 5 for details*
 - B2: =EOMonth(A2, 1)
 - C2: = EOMonth(A2, 2)
 - D2: =EOMonth(A2, 1) + 1

Open "Dates-3-Holidays.xlsx"

1) Sheet "Holidays"

- This list was created by the instructor of this workshop. We are going to use the whole column A in our equations. If you create your own list, please keep in mind, the list can ONLY include dates, NO TITLE.

2) Sheet "Predict End Date", (reformat results as dates, if needed)

- C2: =A2 + B2
- D2: =Workday(A2, B2)
- E2: = Workday (A2, B2, Holidays!A:A)
- AutoFill values for all dates

3) Sheet "# of Days"

- C2: =B2-A2
- D2: =NetworkDays(A2, B2)
- E2: =NetworkDays(A2, B2, Holidays!A:A)
- AutoFill values for all dates

4) See Page 6 for details on WORKDAY and NETWORKDAY

Open " Times-1-FormatsFills.xlsx"

1) Sheet "Shortcuts"

- B2: Enter a number and a colon
- B3: Enter a number between 1 and 12, a space, then an A or P
- Select B2:B3
 - From the Number Format drop down, choose Time
 - Press Shift-Ctrl-2 to Quick-format
 - Format Cells (More Numbers) view Time formats
- B6: Press Ctrl-Semicolon (Ctrl-;)
- B7: Press Ctrl-Colon (Ctrl-:)
- B8: Press Ctrl-Semicolon, press a space, Press Ctrl-Colon
- B11: =Today()
- B12: =Now()

2) Sheet "Time Formats"

- Select B3:E3
 - B3:E3 - Type "1:23 a" and press Ctrl-Enter
 - B4:E4 - Type "1:23 p" and press Ctrl-Enter
 - B5:E5 - Type "36:00" and press Ctrl-Enter

- Custom Format
 - B3:B5 - h:mm am/pm
 - C3:C5 - hh:mm
 - D3:D5 - hh:mm:ss am/pm
 - E3:E5 - [hh]:mm
 1. Brackets to *BREAK IT* out of the 24-hour clock

3) Sheet "AutoFill Times"

- A2: 9 a - AutoFill to Row 10
- B2: 9 p - AutoFill to Row 10

- C2: 6:00
- C3: 12:00
- Select C2:C3
- AutoFill to row 10
 - Reformat to go beyond the 24 hour clock - [hh]:mm

- D2: 0:15
- D3: 0:30
- Select D2:D3
- AutoFill to row 10

- E2: =D2*24
 - Multiply by 24 to mathematically move it out of a time
 - Reformat to a comma format, AutoFill to row 10

Open "Times-2-TimeSheet.xlsx"

- 1) Reported time is Time Out minus Time In
 - a. F2: =(C2-B2) + (E2-D2)
 - b. AutoFill down to Row 6

- 2) Total time is the sum of all the reported times
 - a. F7: AutoSum
 - b. Reformat for 24-hour clock (*brackets*)

- 3) Hours Worked should be linked to Total
 - a. C10: =F7
 - b. C12: =C10*F7
 - i. Answers wrong! Remember 40:00 is not 40 hours
 - c. C10: =F7*24
 - d. Reformat C10 to a comma style

- 4) Exit without saving, and then try to do it again.

FINAL EXERCISE - Redo the Timesheet -- Open "Times-2-TimeSheet.xlsx"

	A	B	C	D	E	F
1	Date	In	Out	In	Out	Reported
2	Mon	8:00	12:00	12:30	16:45	8:15
3	Tue	8:15	11:15	12:30	17:30	8:00
4	wed	8:30	12:45	13:30	17:15	8:00
5	Thu	7:00	12:00	12:30	17:00	9:30
6	Fri	7:45	14:00			6:15
7					Total	40:00
8						
9						
10	Hours Worked		40.00			
11	Hourly Rate		\$ 15.00			
12	Total Due		\$ 600.00			